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L8 ANSWER 5 OF 5 CA COPYRIGHT 2000 ACS
AN 123:304708 CA
TI Plasma etching of silicon-containing material
IN Nawata, Makoto; Yakushiji, Mamoru; Saikai, Masaharu
PA Hitachi Ltd, Japan
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
IC ICM H01L021-3065
ICS C23F004-00; H01L021-304
CC 76-14 (Electric Phenomena)
FAN.CNT 1

Nawata et.al

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 07201814	A2	19950804	JP 1993-334951	19931228 <--
AB	The title method involves cleaning Si,				

polycrust. Si, or silicides with F-contg. gas,
plasma conditioning with Cl and/or HBr, and plasma
etching with Cl and/or HBr. A Si-contg.
material was etched with stable etching rate.
ST plasma etching silicon chlorine; hydrogen bromide
plasma etching silicon; silicide plasma
etching halogen; fluorine cleaning silicon
plasma etching
IT Etching
(plasma etching of silicon-contg. material with
chlorine and/or hydrogen bromide)
IT Silicides
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(plasma etching of silicon-contg. material with
chlorine and/or hydrogen bromide)
IT 2551-62-4, Sulfur hexafluoride 7782-41-4, Fluorine, uses 7783-54-2,
Nitrogen trifluoride 7790-91-2, Chlorine trifluoride 13709-36-9,
Xenon difluoride
RL: NUU (Nonbiological use, unclassified); USES (Uses)
(cleaning gas; plasma etching of silicon
-contg. material with chlorine and/or hydrogen bromide)
IT 7782-50-5, Chlorine, uses 10035-10-6, Hydrogen bromide, uses
RL: NUU (Nonbiological use, unclassified); USES (Uses)
(plasma etching of silicon-contg. material with
chlorine and/or hydrogen bromide)
IT 7440-21-3, Silicon, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(plasma etching of silicon-contg. material with
chlorine and/or hydrogen bromide)
IT 39384-00-4, Silicon fluoride
RL: REM (Removal or disposal); PROC (Process)
(plasma etching of silicon-contg. material with
chlorine and/or hydrogen bromide)

03

TITLE: Plasma etching process - comprises cleaning and seasoning to depress influence of residual matter in treating chamber

PRIORITY-DATA:

1993JP-0334951

December 28, 1993

PATENT-FAMILY:

PUB-NO	JP 07201814 A
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PUB-DATE	August 4, 1995	LANGUAGE	N/A	PAGES	004	MAIN-IPC	H01L021/3065
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INT-CL (IPC): C23F 4/00; H01L 21/304; H01L 21/3065

ABSTRACTED-PUB-NO: JP07201814A

BASIC-ABSTRACT:

After cleaning, a seasoning process is performed by Cl₂, HBr gas plasma, depressing the influence of the residual material in the treating chamber.

ADVANTAGE - The etching rate difference of Si and SiO₂ is controlled by removing residual F, and the uniformity of each wafer is achieved.

L9 ANSWER 5 OF 5 JAPIO COPYRIGHT 2000 JPO
 AN 1995-201814 JAPIO
 TI PLASMA ETCHING METHOD
 IN NAWATA MAKOTO; YAKUSHIJI MAMORU; SAIKAI MASAHIRO
 PA HITACHI LTD, JP (CO 000510)
 PI JP 07201814 A 19950804 Heisei
 AI JP1993-334951 (JP05334951 Heisei) 19931228.
 SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 95, No. 8

IC ICM (6) H01L021-3065
 ICS (6) C23F004-00; (6) H01L021-304
 AB PURPOSE: To prevent fluctuation in a residual oxide film on a substrate surface by suppressing a decrease in the etching speed of silicon and oxide film after cleaning and by performing seasoning with plasma such as Cl₂ gas after cleaning thereby decreasing the influence of residue inside a treatment chamber.
 CONSTITUTION: Microwave oscillated from a magnetron 1 propagates through a wave guide 2 and is introduced to a treatment chamber 4 through a microwave introducing window 3. A cleaning gas (SF₆), seasoning gas (Cl₂ gas) and etching gas (C₂ gas) supplied from an etching gas supply apparatus 8 are turned into plasma. Cleaning of the treatment chamber 4 is performed by SF₆ gas plasma. Seasoning of the treatment chamber 4 is performed by Cl₂ gas plasma. A wafer 10 placed on a mounting electrode 9 is etched by Cl₂ gas. By doing this, the influence of the residual fluorine after cleaning is suppressed, and a decrease in the etching rate of silicon and oxide film can be prevented.

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C 23 F 4/00

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E 8417-4K
F 8417-4K

F 1

技術表示箇所

H 01 L 21/302

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F

審査請求 未請求 請求項の数 3 OL (全 4 頁) 最終頁に統ぐ

(21)出願番号

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平成5年(1993)12月28日

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(54)【発明の名称】 プラズマエッティング方法

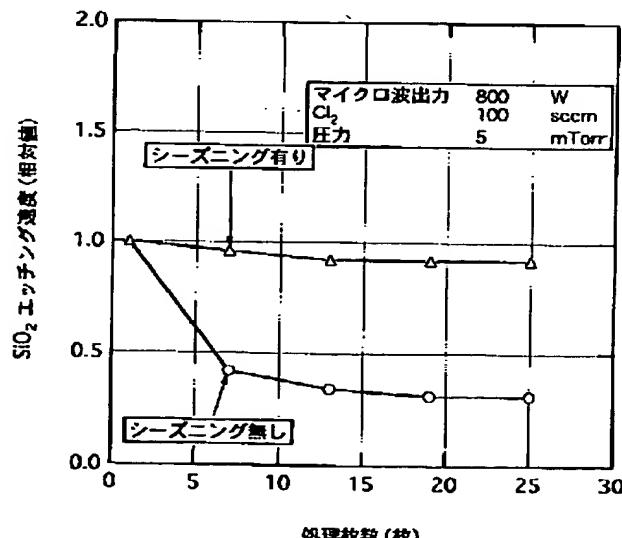
(57)【要約】

【目的】クリーニング後のシリコン及び下地膜である酸化膜 (SiO_2) のエッティング速度の変化を抑制しウエハ間の均一性を向上させるのに好適なプラズマエッティング方法を提供することにある。

【構成】クリーニング後 Cl_2 , HBr ガスプラズマでシーズニングを行い、クリーニング後の処理室内の残留物の影響を減少させる。

【効果】クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッティング速度の変動を防止することができる。

図 2



【特許請求の範囲】

【請求項1】フッ素を含むガスプラズマによりクリーニングを行い、クリーニング後、塩素ガス(C_{l2})、臭化水素ガス(HBr)の単独ガスあるいは混合ガスをエッティングガスとして用いてシリコン、多結晶シリコン、シリサイドのエッティングを行うエッティング装置において、クリーニング後にC_{l2}ガス、HBrガスの単独ガスあるいは混合ガスのプラズマで馴らし放電(シーズニングと称す)を行った後エッティングを開始することを特徴とするプラズマエッティング方法。

【請求項2】請求項1記載のフッ素を含むガスが六フッ化硫黄(SF₆)、三フッ化窒素(NF₃)、二フッ化キセノン(XeF₂)、フッ素(F₂)、三フッ化塩素(C_lF₃)の単独ガスあるいは混合ガスであることを特徴とするプラズマエッティング方法。

【請求項3】請求項1記載のシーズニングにおいてSiFの発光スペクトルをモニターし発光スペクトルの強度の時間変化が一定値以下になった時点でシーズニングを終了しエッティングを開始することを特徴とするプラズマエッティング方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、フッ素を含むガスプラズマによりクリーニングを行い、クリーニング後、塩素ガス(C_{l2})、臭化水素ガス(HBr)の単独ガスあるいは混合ガスをエッティングガスとして用いてシリコン、多結晶シリコン、シリサイドのエッティングを行うエッティング装置に係り、特にクリーニング後のシリコン及び下地膜である酸化膜(SiO₂)のエッティング速度の変化を抑制しウエハ間の均一性を向上させるのに好適なプラズマエッティング方法に関するものである。

【0002】

【従来の技術】従来、エッティングを含めたプラズマプロセスではウエハの粒子汚染を防止するためにクリーニングを行いクリーニング後の処理室内の残留物をなくすためにポストクリーニングを行っている。例えば、SF₆、NF₃ガスをクリーニングに用いた場合にはN₂、Ar、H₂、O₂ガスプラズマがポストクリーニングに用いられている。

【0003】なお、本技術に関連するものとして例えば、文献：平塚豊著、洗浄設計P41-53, 1992. Summerが挙げられる。

【0004】

【発明が解決しようとする課題】従来のエッティング方法では、クリーニング後の処理室内の残留物のエッティング特性に及ぼす影響について考慮がされておらず、クリーニング後処理枚数とともにシリコン及び下地膜の酸化膜のエッティング速度が減少し、下地酸化膜の残膜が変動するという問題点があった。

【0005】本発明の目的は、クリーニング後のシリコ

ン及び酸化膜のエッティング速度の減少を抑制し、下地酸化膜の残膜の変動を防止し、良好なウエハ間の均一性が得られるエッティング方法を提供することにある。

【0006】

【課題を解決するための手段】上記目的を解決するために、クリーニング後C_{l2}ガス、HBrガスのプラズマでシーズニングを行い、クリーニング後の処理室内の残留物の影響を減少させようとしたものである。

【0007】

- 10 【作用】図4に、SF₆ガスプラズマでクリーニングを行った後、C_{l2}ガスプラズマでシリコンをエッティングした場合におけるSiF(波長441nm)の発光スペクトルの処理枚数による変化を示す。シリコンとフッ素の反応によって生成するSiFの発光スペクトルの強度は処理枚数とともに減少しほぼ一定となる。このことからフッ素を含むガスによるクリーニング後、処理室内にはフッ素が残留していることが分かった。図5、図6に、C_{l2}ガスにSF₆ガスを添加した場合のSiFの発光スペクトルとシリコン及び酸化膜のエッティング速度の変化を示す。図5、図6に示すようにSF₆の添加量の増加とともにシリコン及び酸化膜のエッティング速度は増加する。また、SF₆の添加量の増加とともにSiF(波長441nm)の発光スペクトルの強度は増加する。このことから残留フッ素によりシリコン及び酸化膜のエッティング速度は変動し、残留フッ素の減少とともにシリコン及び酸化膜のエッティング速度が低下することを見出した。したがって、クリーニングの後残留フッ素の除去のためHBr、C_{l2}ガスプラズマでシーズニングを行い、SiFの発光スペクトルの強度の時間変化が一定値以下になった時点でシーズニングを終了しエッティングを開始することによりシリコン及び酸化膜のエッティング速度の変動を抑制できる。

【0008】

- 【実施例】本発明の一実施例を図1により説明する。図1は、マイクロ波プラズマエッティング装置の概略図を示したものである。マグネットロン1から発振したマイクロ波は導波管2を伝播しマイクロ波導入窓3を介して処理室4に導かれる。磁界発生用直流電源5からソレノイドコイル6、7に供給される直流電流によって形成される40 磁界とマイクロ波電界によってエッティングガス供給装置8から供給されるクリーニングガス(SF₆)、シーズニングガス(C_{l2}ガス)及びエッティングガス(C_{l2}ガス)はプラズマ化される。SF₆ガスプラズマにより処理室4のクリーニングが行われる。C_{l2}ガスプラズマにより処理室4のシーズニングが行われる。C_{l2}ガスにより載置電極9に載置されているウエハ10がエッティングされる。クリーニング、エッティング時の圧力は真空排気装置11によって制御される。また、ウエハに入射するイオンのエネルギーは載置電極9に高周波電源12から供給される高周波電力によって制御される。図2、図

3

3にシーズニングの有無によるシリコン及び酸化膜のエッチング速度の変化の違いを示す。シーズニングはC12ガスプラズマにより行い、SiF₆の発光スペクトルを10秒毎にモニタし時間t_nと時間t_{n-1}に測定したスペクトルの発光強度比が1±0.002になった時点でシーズニングを停止した。クリーニング後にシーズニングを行うことによりクリーニング時に生成されるフッ素の残留の影響を抑制しエッチング速度の変動を防止できる。

【0009】本発明によれば、クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができる。

【0010】本実施例ではマイクロ波プラズマエッティング装置についてその効果を説明したが、他の放電方式例えればプラズマエッティング(P.E.)、ヘリコン、TCPにおいても同様な効果が得られる。

【0011】

【発明の効果】本発明によれば、クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング

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速度の変動を防止することができる。

【図面の簡単な説明】

【図1】本発明の一実施例のマイクロ波プラズマエッティング装置の構成図である。

【図2】本発明の一実施例での効果を説明するためのSiO₂エッチング速度の処理枚数依存性示す説明図である。

【図3】本発明の一実施例での効果を説明するためのSiエッチング速度の処理枚数依存性示す説明図である。

【図4】SiF₆発光強度の処理枚数依存性示す説明図である。

【図5】SiF₆発光強度のSF₆添加量依存性を示す説明図である。

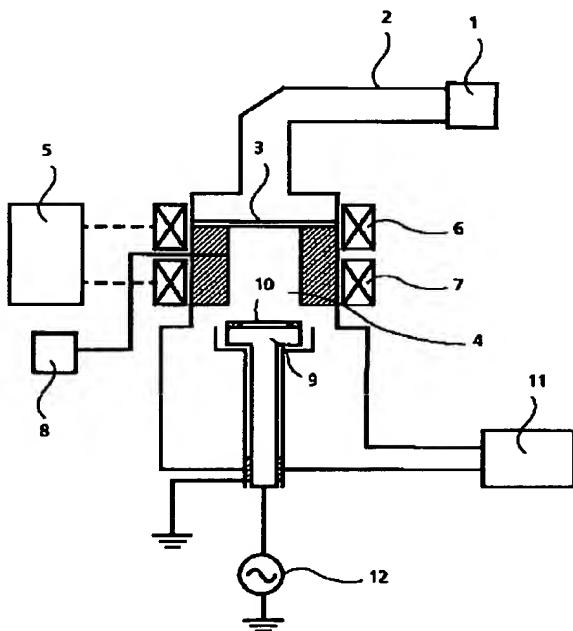
【図6】Si及びSiO₂エッチング速度のSF₆添加量依存性を示す説明図である。

【符号の説明】

2…マイクロ波導入窓、3…放電管、4…ソレノイドコイル、6…基板。

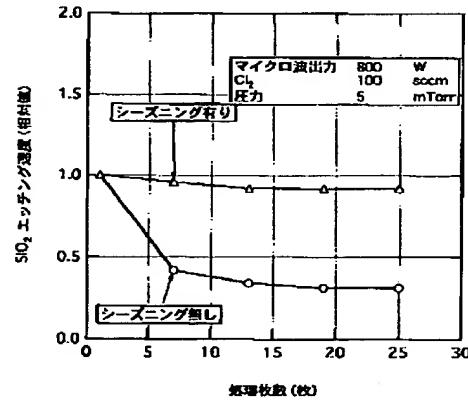
【図1】

図 1



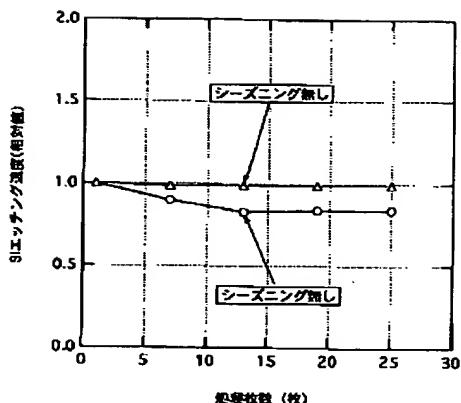
【図2】

図 2



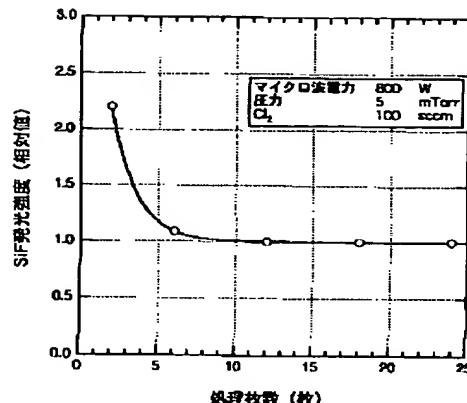
【図3】

図 3



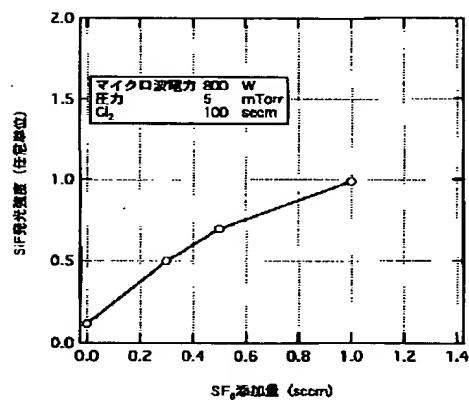
【図4】

図 4



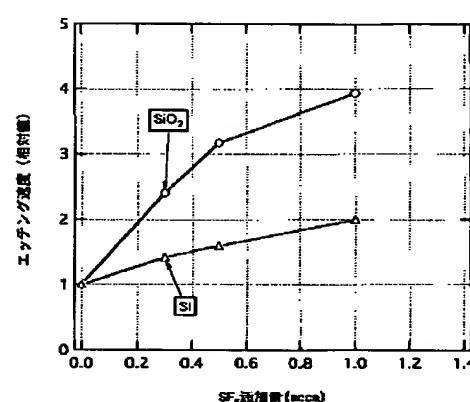
【図5】

図 5



【図6】

図 6



フロントページの続き

(51) Int.Cl.6

H 01 L 21/304

識別記号 庁内整理番号

341 D

F 1

技術表示箇所

* NOTICES *

07-201, 814

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CLAIMS

[Claim(s)]

[Claim 1] The plasma-etching technique characterized by starting etching after discharging by cleaning by the gas plasma containing a fluorine and accustoming after cleaning in silicon, polycrystal silicon, and the etching system that performs etching of a silicide with the plasma of the independent gas of Cl₂ gas and HBr gas, or mixed gas, using the independent gas or mixed gas of after cleaning, chlorine gas (Cl₂), and hydrogen-bromide gas (HBr) as etching gas (seasoning is called).

[Claim 2] The plasma-etching technique characterized by the gas containing a fluorine according to claim 1 being the independent gas or mixed gas of 2 3 fluoride [6 fluoride / sulfur / (SF₆) and nitrogen] (NF₃) and xenon fluoride (XeF₂), a fluorine (F₂), and 3 fluoride-salt ** (ClF₃).

[Claim 3] The plasma-etching technique characterized by ending seasoning and starting etching when it acts as the monitor of the emission spectrum of SiF in seasoning according to claim 1 and time change of the intensity of an emission spectrum becomes below a constant value.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] It is related with the suitable plasma-etching technique for this invention to clean by the gas plasma containing a fluorine, and take for silicon, polycrystal silicon, and the etching system that performs etching of a silicide after cleaning, using the independent gas or mixed gas of chlorine gas (Cl₂) and hydrogen-bromide gas (HBr) as etching gas, especially suppress change of the etch rate of the oxide film (SiO₂) which is the silicon and the substratum layer after cleaning, and raise the homogeneity between wafers.

[0002]

[Description of the Prior Art] Conventionally, in the plasma process including etching, in order to clean in order to prevent grain contamination of a wafer, and to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. For example, when SF₆ and NF₃ gas are used for cleaning, N₂, Ar, H₂, and O₂ gas plasma are used for post cleaning.

[0003] In addition, reference Hiratsuka ****, washing design P 41-53, and 1992.Summer are mentioned as a thing relevant to this technique.

[0004]

[Problem(s) to be Solved by the Invention] By the conventional etching technique, consideration was not carried out about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.

[0005] The purpose of this invention suppresses a decrement of the silicon after cleaning, and the etch rate of an oxide film, prevents change of **** of a substratum oxide film, and is to offer the etching technique by which the homogeneity between good wafers is acquired.

[0006]

[Means for Solving the Problem] In order to solve the above-mentioned purpose, seasoning tends to be performed with the plasma of after [cleaning] Cl₂ gas and HBr gas, and it is going to decrease the influence of the residue of the processing interior of a room after cleaning.

[0007]

[Function] After cleaning to drawing 4 with SF₆ gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl₂ gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF₆ gas in Cl₂ gas, silicon, and an oxide film is shown in drawing 5 and the drawing 6. As shown in drawing 5 and the drawing 6, the etch rate of silicon and an oxide film increases with the increase in the addition of SF₆. Moreover, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF₆. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine. Therefore, seasoning is performed with HBr and Cl₂ gas plasma for elimination of the post-remains fluorine of cleaning, and when time change of the intensity of the emission spectrum of SiF becomes below a constant value, change of the etch rate of silicon and an oxide film can be suppressed by ending seasoning and starting etching.

[0008]

[Example] Drawing 1 explains one example of this invention. Drawing 1 shows the schematic diagram of a microwave plasma etching system. The microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the microwave introduction aperture 3. The cleaning gas (SF₆), the seasoning gas (Cl₂ gas), and etching gas (Cl₂ gas) which are supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8 are plasma-ized. Cleaning of the processing room 4 is performed by SF₆ gas plasma. Seasoning of the processing room 4 is performed by Cl₂ gas plasma. It is etched in the wafer 10 currently laid in the installation electrode 9 by Cl₂ gas. The pressure at the time of cleaning and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12. The difference in change of the etch rate of the silicon by

the existence of seasoning and an oxide film is shown in drawing 2 and the drawing 3. Cl₂ gas plasma performed seasoning, and seasoning was suspended when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time t_n and time t_{n-1} was set to 1**0.002. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented.

[0009] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

[0010] Although this example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (PE), for example, a plasma etching, Helicon, and TCP.

[0011]

[Effect of the Invention] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

[Translation done.]

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Field

[Field of the Invention] It is related with the suitable plasma-etching technique for this invention to clean by the gas plasma containing a fluorine, and take for silicon, polycrystal silicon, and the etching system that performs etching of a silicide after cleaning, using the independent gas or mixed gas of chlorine gas (Cl₂) and hydrogen-bromide gas (HBr) as etching gas, especially suppress change of the etch rate of the oxide film (SiO₂) which is the silicon and the substratum layer after cleaning, and raise the homogeneity between wafers.

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Technique

[Description of the Prior Art] Conventionally, in the plasma process including etching, in order to clean in order to prevent grain contamination of a wafer, and to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. For example, when SF₆ and NF₃ gas are used for cleaning, N₂, Ar, H₂, and O₂ gas plasma are used for post cleaning. [0003] In addition, reference:Hiratsuka ****, washing design P 41-53, and 1992.Summer are mentioned as a thing relevant to this technique.

[Translation done.]

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Effect

[Effect of the Invention] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the conventional etching technique, consideration was not carried out about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.

[0005] The purpose of this invention suppresses a decrement of the silicon after cleaning, and the etch rate of an oxide film, prevents change of **** of a substratum oxide film, and is to offer the etching technique by which the homogeneity between good wafers is acquired.

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned purpose, seasoning tends to be performed with the plasma of after [cleaning] Cl₂ gas and HBr gas, and it is going to decrease the influence of the residue of the processing interior of a room after cleaning.

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OPERATION

[Function] After cleaning to drawing 4 with SF₆ gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl₂ gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF₆ gas in Cl₂ gas, silicon, and an oxide film is shown in drawing 5 and the drawing 6. As shown in drawing 5 and the drawing 6, the etch rate of silicon and an oxide film increases with the increase in the addition of SF₆. Moreover, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF₆. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine. Therefore, seasoning is performed with HBr and Cl₂ gas plasma for elimination of the post-remains fluorine of cleaning, and when time change of the intensity of the emission spectrum of SiF becomes below a constant value, change of the etch rate of silicon and an oxide film can be suppressed by ending seasoning and starting etching.

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EXAMPLE

[Example] Drawing 1 explains one example of this invention. Drawing 1 shows the schematic diagram of a microwave plasma etching system. The microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the microwave introduction aperture 3. The cleaning gas (SF₆), the seasoning gas (Cl₂ gas), and etching gas (Cl₂ gas) which are supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8 are plasma-ized. Cleaning of the processing room 4 is performed by SF₆ gas plasma. Seasoning of the processing room 4 is performed by Cl₂ gas plasma. It is etched in the wafer 10 currently laid in the installation electrode 9 by Cl₂ gas. The pressure at the time of cleaning and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12. The difference in change of the etch rate of the silicon by the existence of seasoning and an oxide film is shown in drawing 2 and the drawing 3. Cl₂ gas plasma performed seasoning, and seasoning was suspended when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time t_n and time t_{n-1} was set to 1**0.002. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented.

[0009] According to this invention, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented.

[0010] Although this example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (PE), for example, a plasma etching, Helicon, and TCP.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram of the microwave plasma etching system of one example of this invention.

[Drawing 2] It is processing number-of-sheets dependency **** explanatory drawing of SiO₂ etch rate for explaining the effect in one example of this invention.

[Drawing 3] It is processing number-of-sheets dependency **** explanatory drawing of Si etch rate for explaining the effect in one example of this invention.

[Drawing 4] It is processing number-of-sheets dependency **** explanatory drawing of SiF photogenesis intensity.

[Drawing 5] It is explanatory drawing showing SF₆ addition dependency of SiF photogenesis intensity.

[Drawing 6] It is explanatory drawing showing SF₆ addition dependency of Si and SiO₂ etch rate.

[Description of Notations]

2 [-- A solenoid coil, 6 / -- Substrate.] -- A microwave introduction aperture, 3 -- The discharge tube, 4

[Translation done.]